XXV. *Anatomical Observations on the Natural Group of* Tunicata, *with the Description of three Species collected in Fox Channel during the late Northern Expedition. By William Sharp MacLeay, Esq., A.M. F.L.S. Communicated by the Zoological Club of the Linnean Society.*

Read June 15, 1824.

It is almost unnecessary to state to the Linnean Society, which has received so many acquisitions to its Museum and so many valuable communications for its Transactions, in consequence of the late Northern Expeditions, that almost all the gentlemen under the orders of Captain Parry, as well as this distinguished commander himself, earnestly occupied themselves during their dreary residence in the North in collecting objects of Natural History. One of these gentlemen, William Nelson Griffiths, Esq., has brought home from Winter Island one of the best collections of invertebrate marine animals that I have seen from those regions; and it is with a feeling of great satisfaction that I take this opportunity of publicly expressing my thanks to his brother, John Griffiths, Esq., in whose possession the collection now is, for most liberally allowing me not only to examine, but to dissect, such specimens as I might conceive to merit minute attention. Among these animals are three species of simple *Tunicata*, the anatomical description of which will, I hope, interest the Society, as this group of animals, although so low in the creation, has, in consequence of the late investigations of M. Cuvier, and particularly

larly those of M. Savigny, attracted a considerable portion of public attention.

Although it is a proposition now almost undisputed, that Zoology cannot be satisfactorily studied without comparative anatomy* being taken for its basis, perhaps it may not be amiss to cite as examples of the truth of this assertion the singular discoveries of Savigny on the compound *Tunicata*. The wonderful facts which this distinguished naturalist has recorded could never have been discovered by him had he confined his attention to external appearances. Disdaining to rest contented with the manufacture of names, he employed himself in the investigation and generalization of physiological facts; and his discovery of compound *Tunicata* I conceive to be such as may deservedly be placed at the side of that of the metamorphosis of Batrachian reptiles, or any other important physiological fact whatever. Dissection, indeed, must always be resorted to when we wish to understand the structure of the *Tunicata*, whether simple or compound; and the naturalist who contents himself with describing the external appearance of an *Ascidia* may remain even more ignorant of the nature of the inclosed animal, than that person is of *Mollusca* who knows no more of them than the shells they once inhabited. Hence it is that Cuvier says, "La forme exterieure des Ascidies etant sujette à beaucoup de variations, leur surface offrant peu de differences, leur couleur ne se conservant pas après la mort, et differant probablement pendant la vie selon l'age et les lieux ou elles ont pris leur croissance, il est malaisé de les distinguer surement quand on n'a pas recours à leur interieur." So well aware was Aristotle of this truth, that he has given us an anatomical account of such species of *Ascidiæ* as he was acquainted with, so detailed and so accurate as to puzzle his

* Something like the converse of this proposition is also true; namely, that no comparative anatomist is worthy of the name who is not also a zoologist.

commen-

commentators, and to lead some of them to believe that his description was in fault rather than their own knowledge of Natural History.

The *Tunicata* have always been interesting to me as an osculant group connecting the polype *Acrita* and acephalous *Mollusca*. That this situation, assigned to them in the *Horæ Entomologicæ*, is natural cannot now for a moment be doubted. Their relation to the testaceous *Mollusca* has been pointed out by Aristotle, Baster, Linnæus, Pallas, Cuvier, and Savigny. Their relation to the Polypes has likewise been shown by M. Savigny, when he demonstrated that the *Alcyonium ficus* of Linnæus (*Alcyonium pulmonarium* of Solander and Ellis) is nothing else than an aggregation of minute *Ascidiæ* combined in a common envelope.

It is rather curious, indeed, to remark, that the affinity of these animals to *Mollusca*, although so early noticed, is less striking* to modern naturalists than that affinity which they bear to Polypes, and which was only discovered the other day.

Savigny has distinguished the *Tunicata* by their having a soft test or covering consisting of an organized envelope, provided with two orifices, the one branchial, the other anal†. By one of these orifices the *Ascidia* imbibes the sea-water and introduces it into the branchial cavity; and every person in the habit of observing these singular animals knows that almost the only sign of life which they exhibit on being irritated is the spirting out of this water from the branchial cavity. But for a general account of the structure of that group of *Tunicata* which comprises the

* M. de Blainville, however, compares them particularly with the genus *Mya*. See *Dict. des Sciences Natur.* art. *Mollusque*, p. 363.

† If this character be correct, as there is every reason to believe it to be, the imperfectly known genus *Mammaria* will, if truly described by Müller, not belong to the group, although it has been placed here by M. Lamarck. There is great obscurity, however, hanging over this genus as well as *Bipapillaria*, which, upon the authority of some manuscript notes of Peron, is said to have rigid tentacula.

Tethya

Tethya of Aristotle, or *les Ascidiens* of Savigny, I cannot do better than cite the description given by the ancient philosopher, and mentioned above.

In his *Historia Animalium*, under the head of Testaceous Animals (τὰ ὀστρακόδερμα), he observes that "there are some, such as those called Τήθυα, which are so entirely surrounded by their test or envelope* as to have no part of their flesh exposed." So far this accurate and philosophically drawn character may apply to the whole of the *Tunicata:* but Aristotle afterwards proceeds to describe the *Tethya* in the following more definite terms. "But of all these animals (viz. τὰ ὀστρακόδερμα), those which are called *Tethya*† have the most remarkable nature: for with them alone is the body entirely concealed in the test. This test or envelope‡ (τὸ ὄστρακον) is between the texture of leather and shell, and may consequently be cut like a piece of tough hide. The animal adheres to the rocks by its test, and has two passages or orifices (πόρους), distant from each other, and so small as not to be easily visible. By means of these it imbibes and discharges the water.

"On opening one of these animals, the inside presents, in the first place, a membrane composed as it were of nervures§ (ὑμένα

* Ἔστι δ' ἃ ὅλα περιέχεται τῷ ὀστράκῳ καὶ οὐθὲν τῆς σαρκὸς ἔχει εἰς τὸ ἔξω γυμνὸν, οἷον τὰ καλούμενα τήθυα.

† As Aristotle afterwards mentions the colours of such species of *Tethya* as he was acquainted with, it seems probable that his species were the *Ascidia microcosmus* Cuv. and *Ascidia papillosa* Linn.

‡ In the original, "τὸ δ' ὄστρακόν ἐστι μεταξὺ δέρματος καὶ ὀστράκου." This passage is curious, as showing Aristotle's disposition to generalize; a disposition so rare among modern comparative anatomists, that we need not be surprised at observing some of them to be perfectly ignorant of Natural History.

§ This is a good description of the beautifully reticulated membrane which forms the branchiæ of the *Tethya*, and will be easily understood on referring to the dissection of *Dendrodoa glandaria*, as given Pl. XX. fig. 5. Aristotle appears, however, by some mistake to have considered the branchial pouch as *surrounding* the intestine.

νευρώδη),

νευρώδη), and communicating with a fleshy intestine (τὸ σαρκῶδες); so that the intestine of the *Tethyon* appears contained in this reticulated membrane. Although, indeed, the flesh is alike in all testaceous animals, this intestine resembles in form that of none of them. It is suspended at two places, viz. to the above-mentioned membrane, and to the muscle* which proceeds from the side; and wherever it adheres to either of these it is narrowest. At each point of suspension this intestine tends towards those orifices which lead to the outside of the test, and by which it receives and discharges its food and water; so that if one of these apertures be the animal's mouth, the other must be its anus. One of these orificial processes is thicker† than the other. Within the cavity also of one or other of them there is a certain small cohering substance which divides it."

These preliminary remarks, and particularly this accurate though ancient description of an *Ascidia*, will be sufficient to enable any person to pursue the tenour of the following descriptions: but in order to understand them thoroughly, I need scarcely say that a perusal of the admirable memoirs of Cuvier and Savigny is indispensable.

The Tunicata‡, then, are animals which connect the *Acrita* or lowest primary division of the animal kingdom with the *Mollusca*. From the *Mollusca*, however, they differ in having an external covering consisting of an envelope distinctly organized and provided with two apertures, of which one is branchial, the other anal. They also differ from the *Mollusca* as well in their mantle

* Literally it is "to the skin from the side;" and in fact the suspending muscle is exceedingly like a piece of the tunic.

† This is the branchial orifice; and I suspect that the small cohering or continuous substance which Aristotle alludes to immediately afterwards, is the valvule of the anal orifice.

‡ According to his usual practice of changing names,—a practice which interferes so much with his well-merited reputation,—M. de Blainville calls this group *Heterobranchiata*, a name without one single quality to recommend it.

forming an internal tunic corresponding to the outer covering or test, and provided like it with two openings, as in having branchiæ which occupy all, or at least part of the membranaceous cavity formed by the internal sides of the mantle. From the *Acrita* they differ in having distinct nervous and generative systems, while their intestinal canal is provided with two openings both internal.

This osculant group may be divided as follows:

TUNICATA.

Aberrant group?	*Families.*	*Animals.*	*Generic Types.*
1. TETHYA. Or such *Tunicata* as have their mantle adhering to the envelope or test only at their orifices;—their branchiæ regular, constituting the sides of the respiratory cavity; and their branchial orifice surrounded by a membranaceous ring, which in general is supplied with tentacula, as in Polypes	1. ASCIDIDÆ*. *Tethyes simples* Sav.	Simple and fixed, having their orifices externally irregular	ASCIDIA.
	2. BOTRYLLIDÆ. *Teth. composées* Sav.	Compound and fixed, having their orifices externally regular	POLYCLINUM.
	3. LUCIDÆ. *Lucies* Sav.	Compound and floating, having their branchial cavity open at the two extremities.....	PYROSOMA.
Normal group?			
2. THALIDA. Or such *Tunicata* as have their mantle adhering every where to the envelope; their branchiæ irregular, consisting of two foliated processes attached to the sides of the thorax; and their branchial orifice merely provided with a valvule.....	4. BIPHORIDÆ.	Aggregated in their young state, and floating	SALPA.
	5. *******	.....	******

The

* De Blainville considers that the *Pyura Molinæ* makes the passage from the simple to the compound *Tethya*; that is, from the *Ascididæ* to the *Botryllidæ*. Savigny shows

The Tethya of Aristotle, or, as Pliny calls them, the *Tetheæ*, are in general incapable of locomotion; and the three species of which I now propose to explain the structure, seem all to have been dredged from the bottom of the Northern seas, where they lay fixed either to submarine rocks, sand, or sea-weed, or to other animals sedentary like themselves. These species all belong to the natural family of *Ascididæ*, which corresponds in every respect but name with M. Savigny's *Tethyes simples*.

Subgenus. BOLTENIA Sav.

External Character. *Body* with a coriaceous test, supported from the summit by a long pedicle, and having both orifices lateral and cleft into four rays.

Anatomical Character. *Branchial pouch* divided into longitudinal folds, surmounted by a circle of compound tentacula, and having the reticulation of its respiratory tissue simple. *Abdomen* lateral. *Ovary* multiple.

This generic character differs in some respects from that of M. Savigny, and is reformed, for anatomical reasons, which I shall hereafter explain at length in my description of the only species of the subgenus which I have seen from the late Expedition. It is the same species of Linnean *Ascidia* concerning which Captain Sabine says in the Appendix to Captain Parry's First Voyage, that it was not unfrequently taken by the trawl on the west coast of Davis's Strait, in lat. 70°. It is also, as this ardent lover

shows the affinity of these to *Pyrosoma*, and of *Pyrosoma* to *Salpa* or (as it is sometimes called, although the name is preoccupied in Botany) *Thalia*. De Blainville, indeed, goes so far as to call the *Lucidæ* "*Salpiens aggregés*"; and although no great stress ought to be laid on this author's arrangement, from his obvious wish to obliterate the inimitable labours of Savigny, it is clear that the affinity between *Pyrosoma* and *Salpa* is strong. A fifth group of the *Tunicata* is wanting to connect the *Biphoridæ* with the *Ascididæ*; and I have no doubt that such animals will soon occur to reward the industry of those who collect *Mollusca* and *Acrita*.

of science remarks, the *Ascidia clavata* of Otho Fabricius, but not that of Pallas, which now forms the type of Savigny's genus *Clavellina*. It is not, however, as Captain Sabine supposes, the *Ascidia globifera* of Lamarck, since the body of this species is subglobose and not sub-reniform, as in the animal described by Captain Sabine and by Otho Fabricius. The mistake has originated in the circumstance of Lamarck citing Bruguières's figure of his *A. pedunculata* as a synonym for his *A. globifera*. This, however, is no error of Lamarck; for the synonym is correct, but unfortunately, Bruguières's figure being a vile copy of a bad figure of Edwards, who has represented the branchial orifice of his *Animal-Planta* as somewhat simple and not quadrifid, as it ought to have been, Captain Sabine was induced to confide in the accuracy of Bruguières's figure rather than in that of Lamarck's synonym.

With respect to the *Ascidia pedunculata* I may observe, that not only Bruguières's figure of it in the *Encyclopédie Méthodique*, but also the one given by Shaw in the *Zoological Miscellany*, is a miserable copy of the above figure of Edwards's *Animal-Planta*, which is, as Dr. Shaw suspected, and as M. Savigny has shown, no other than the *Vorticella ovifera* of Linnæus. Dr. Shaw's figure of it is merely a reversed copy of Edwards's figure, retaining the same unnatural position and the same error, only more strongly marked, of the branchial orifice.

Having thus ascertained the identity of Lamarck's *Ascidia globifera* with *A. pedunculata* of Bruguières and Shaw, with the *Vorticella ovifera* of Linnæus, and the *Animal-Planta* of Edwards, nothing remains to be said on its nomenclature, except that it is the *Boltenia ovifera* of Savigny, who has most ably explained its anatomical structure.

It appears, therefore, that the animal now before me from Winter Island is not the true *globifera* of Lamarck, as may be ascertained on inspection of any of the above-mentioned figures.

Neither

Neither is it the *Ascidia pedunculata* of Lamarck, which is the *Ascidia clavata* of Shaw's *Zoological Miscellany*, the *Vorticella Bolteni* of Linnæus in the *Mantissa Plantarum*, and the *Boltenia fusiformis* of Savigny. This last animal, however, as Savigny suspected, comes much nearer than the *A. globifera* of Lamarck to the *Ascidia clavata* of Otho Fabricius, which, as I before said, is the *Ascidia globifera* of Captain Sabine, and one of the animals Mr. Griffiths has brought from Winter Island. It thus appears that considerable confusion has arisen in the application of the trivial names *pedunculata*, *clavata*, and *globifera;* and I shall therefore offer the following synopsis of the only three species of *Boltenia* which are yet satisfactorily known to exist, and which are all peculiar to the Arctic seas.

Spec. 1. Boltenia ovifera.

B. murina scabra vel potius hirsuta, corpore ovato, orificiis vix prominentibus, pedunculo sublaterali.

Boltenia ovifera. *Sav. Mem. vol.* i. *p.* 140. *tab.* 1. *fig.* 1.

Ascidia globifera. *Lamarck, Anim. sans Vert. vol.* iii. *p.* 127.

——— pedunculata. *Shaw, Zool. Miscell. vol.* vii. *tab.* 239. *Bruguières, Enc. Meth. no.* 12. *tab.* 63. *fig.* 12. 13.

Vorticella ovifera. *Linn. Syst. Nat. ed.* 13. *p.* 1319. 14.

Animal-Planta. *Edwards, tab.* 356.

Priapus pedunculo filiformi corpore ovato *Alex. Russel in Phil. Trans. vol.* lii. *p.* 556. *tab.* xvii. (figuris malis).

Animal aquatique. *Bigot de Morogues, in Mém. Etrang. de l'Acad. des Scien. de Paris, tom.* ii. *p.* 145. *cum tabulâ pessimâ?*

Spec. 2. Boltenia fusiformis.

B. obscure rufa vix scabra, corpore elongato-ovato, orificiis prominentibus, pedunculo terminali.

Boltenia fusiformis. *Sav. Mem. vol.* i. *p.* 141.

Ascidia pedunculata. *Lam. Anim. sans Vert. vol.* iii. *p.* 127.

Ascidia

Ascidia clavata. *Shaw, Zool. Miscell. vol.* v. *tab.* 154.
Vorticella Bolteni. *Linn Mantiss. Plant. app. p.* 552.
Zoophytorum genus novum. *Fred. Bolten, Epist. Hamb.* 1770. *cum tabulâ.*

Spec. 3. Boltenia reniformis.

B. obscura scabriuscula, corpore subreniformi, orificiis sub-prominentibus, pedunculo terminali.
Ascidia globifera. *Capt. Sabine in App. no.* x. *to Parry's Voyage to Melville Island.*
——— clavata. *Otho Fab. Faun. Groen. no.* 323. *Müller, Zool. Dan. Prod.* 2740. (secundum Fabricium, sed descriptio apud Müllerum nimis est indefinita et omnibus his speciebus idonea.)
Inhabits the northern seas of America.

Descr. *Envelope* sub-pellucid, whitish. *Mantle* or *tunic* very thin, provided with transverse circular narrow muscles, which cut each other very obliquely.
Tentacula about ten or twelve in number, very unequal, clavate, with the clava plumiform or beautifully divided into a number of regular laciniæ.
Branchial pouch marked with about fifteen or sixteen large folds, and having the net-work simple and regular as in the *Cynthia momus* of Savigny.
Dorsal sulcus having the two lateral filaments winged and the intermediate simple.
Œsophagus descending vertically to the lower end of the body, as suspended, and there meeting an ascending ovoidal stomach without any apparent internal folioli.
Intestine with an oblong longitudinal open loop, which is prolonged to the *pedicle*. *Rectum* narrow and sub-conical, and ascending nearly parallel to the œsophagus, only higher. *Anus* having a scolloped margin.

Liver

Liver coating the stomach behind the right ovary, and running from the lower end of the body, as suspended, about half way up. It is divided into several granulated lobes, some of which are separated from the others, particularly towards the pharynx.

Ovaries two, elongate, lobate, situated on each side of the body, and directed towards the anal orifice. *Right ovary* straight, claviform, lying close within the loop of the intestine. *Left ovary* larger and less lobate, but undulated and extending downwards behind the branchial vein.

The *body* of this singular animal is kidney-shaped, suspended to a cylindrical *pedicle*, very narrow and very long. Both the body and pedicle are scabrose, or covered with a rough surface, which is formed by exceedingly short coarse hairs. The original colour I cannot ascertain; but in spirits it is cinereous or dirty white, which may possibly be the true colour of the animal, as it is not unfrequently that of other *Ascidiæ*. The external *orifices* are placed both on the same side of the body; the *branchial* near the pedicle, and the *anal* near the opposite extremity, but both on the same line with the base of the pedicle: thereby differing from the *Boltenia oviformis* of Savigny, which has, as this naturalist says, the pedicle inserted, not precisely at the summit, but at its side. These orifices are cleft in a cross of four rays, and are not very prominent. The entrance of the branchial cavity is provided with a circular range of tentacula, which are composite, or divided at the extremity into a number of minute slips, or laciniæ of a regular form, which are attached to the edge of certain membranaceous folioles, into which the membrane forming the root as it were of the tentaculum, appears to branch.

The *dorsal sulcus* very nearly resembles that of *Ascidia momus*, as figured by Savigny, Plate vi. fig. 1., except that the lateral cordons are not transversely striated.

The

The *pharynx* is lower than the anal orifice, but is not, as in the *B. oviformis* of Savigny, at the lowest part of the cavity of the body; neither is the anus descending, as he represents it in that animal. The œsophagus descends, and conducts to a simple ascending stomach, provided with an ample liver, composed of many irregular lobes, the surface of which is minutely papillose or composed of rounded grains, which at first sight resemble ova. The larger lobes of the liver are attached to that part of the stomach which is nearest to the pylorus, *i.e.* highest. M. Savigny has denied the presence of a liver in his species of *Boltenia*, and has even made its absence to be one of the characters of the genus*! If he be correct in this observation, which a person who has had so many opportunities as I have had, to admire his consummate accuracy, can scarcely doubt, then there is a very important difference between his two species and mine; so important, indeed, as to render me most desirous of having an opportunity of examining the *B. oviformis* anatomically.—But to proceed with the details of *B. reniformis:* its long intestine mounts up as high as the base of the pedicle, and then descends nearly parallel to itself, and terminates in an ascending conical rectum and scolloped anus. There are two ovaries, unequal in size, but both placed longitudinally, so as to terminate near the anal orifice. The smaller ovarium is on the side of the intestines, fitting closely into the ascending loop formed by the stomach and intestine. It is clavate, rather straight, and formed, towards the extremity, of sub-cubical lobes, which contain the ova. The larger ovary is on the opposite side, between the mantle and branchial pouch: it is undulated, and not so lobated as the other. All

* In that part of the article *Mollusca*, in the Supplement to the *Encyclopædia Britannica*, which relates to these animals, and which, by the bye, is little more than a transcript of Savigny's admirable memoirs, we find the genus *Boltenia* characterized as having no liver.

these

these viscera are enveloped in a mantle, of which the summit is prolonged and fills the interior of the pedicle, as Savigny says, like a marrow. The muscles with which the mantle is supplied are very narrow circular fasciæ, crossing each other at very oblique angles, and may thus be easily distinguished from the nervures of the branchial net. The internal structure of *Boltenia reniformis* is, in short, so near that of *Cynthia momus* and *C. pantex*, that the generic difference which M. Savigny has stated to exist between them rests principally on their external structure, and the presence or absence of a pedicle.

It is easy for the naturalist now to perceive that those figures of *Boltenia*, which represent them as supported vertically on a rigid peduncle, give them an unnatural position; that is, a position where the branchial pouch, and consequently the œsophagus, instead of descending, ascend. The pedicle, indeed, is clearly flexible in a natural state, in order that its drooping by the weight of the body may give this last a position analogous to that of other *Ascididæ*. When such animals exist, supported by a rigid peduncle, this must be inserted at the other extremity of the body, as in the genus *Clavellina* of Savigny, the compound family of *Botryllidæ*, and perhaps the *Ascidia globularis* of Pallas and Lamarck. It seems necessary for the digestion of *Ascididæ*, if, at least, we may judge from their general construction, that the intestinal canal should form a loop or *ansa*. This loop, however, may be either ascending, as in *Boltenia*, or descending, as in *Clavellina;* the only circumstance common to both genera being, that the *loop* points towards the pedicle.

In the compound *Tunicata* of the family of *Botryllidæ* the pedicle seems to be a receptacle for the eggs, as in certain Cirripedes. In *Clavellina* it may possibly be the same; but whether it be also the case in *Boltenia* is not so certain.

The genus *Boltenia* evidently enjoys some degree of locomotion when its flexible pedicle is agitated to and fro by the waves; and it is not improbable that some points of its construction render this oscillation necessary to its comfortable existence: for we may observe, that one of those *Ascididæ* which come the nearest to it in structure (the *Cynthia momus* of Savigny) does not attach itself to rocks, but makes shift to float about in the Gulf of Suez by attaching itself to fuci and other submarine plants.

The second animal which I have to illustrate is sufficiently distinct from the former to allow me to form a new

Subgenus. CYSTINGIA.

External Character. *Body* with a sub-coriaceous test, affixed by the summit to a very short pedicle, which is in the same line with the two orifices. The *branchial orifice* quadrifid and lateral, the *anal* irregular and terminal; both being so little prominent as not to alter the form of the body.

Anatomical Character. *Branchial pouch* membranaceous, indistinctly reticulated, and divided into longitudinal folds. The *tentacula* of the branchial orifice composite. *Intestinal canal* lateral. *Stomach* very large, extending almost the whole length of the body. *Ovaries* two, composed of globular ova disposed in free racèmes on each side of the body, with the branchial pouch and stomach between them.

This genus comes nearer to *Boltenia* than to any other hitherto described; and they may prove eventually to be only two subgenera,

genera, of which we want the intervening links to enable us to form an accurate notion of the genus to which they belong. At present, however, the characters, both internal and external, of the animal which I am about to describe, are so different from those given as generic by Savigny to *Boltenia*, that it is impossible to assign it to this group, which indeed has nothing in common with it, but externally a pedicle, and internally composite tentacula.

Pallas has in the *Nova Acta Petropolitana* described under the name of *Ascidia globularis* a species of this family, which he found during his Siberian journey plentiful on the shallow sandy shores of the Arctic Ocean; and as his description is very vague, and principally differs from that of the species before me in respect to size and the position of the apertures, it is just possible that the same animal may be intended; a circumstance which would be rather interesting in a geographical point of view. He describes it as being of the size of a large cherry, and fixed by a very short peduncle to the fine sand of those shores, the particles of which being agglutinated to its surface, make it appear rough.

If, however, both the apertures of the animal described by Pallas be truly terminal, and the peduncle be placed as represented in his figure, it is not only a different species from the following, but probably a very different genus.

Cystingia Griffithsii.

C. ovato-globosa cineracea glabra semipellucida, pedunculo vix longitudine corporis.

Tab. XIX.

Descr. *Envelope* semipellucid, yellowish. *Mantle* very thin, and provided near the branchial and anal orifices with a reticulation of circular muscles nearly at right angles to each other.

Tentacula about ten or twelve, compound and laciniated like those of the genus *Boltenia*.

Branchial pouch having its net-work exceedingly lax, meshes irregular and indistinct, but apparently simple, the nervures being nearly of the same size. The longitudinal folds of the branchiæ, or rather (owing to the singular position of them in this genus) their transverse folds, about fourteen or fifteen in number.

Length of body half an inch.

I have named this new species after the gentleman to whom I owe my acquaintance with its structure, and who appears to have found only this one specimen of it during the late voyage. And I shall now enter into the discussion of its anatomy with as much detail as the possession of only one specimen will enable me to do.

The body of this animal, so different in many respects from all other *Tethyæ*, is pyriform, and attached to a pedicle so short as scarcely to curve down further than the branchial orifice. This pedicle is rather conical at its base, sub-cylindrical and apparently very weak at its extremity. From this apparent weakness and imperfect formation of the pedicle, in conjunction with the circumstance of one side of the conical part in the only specimen that I have seen being encrusted with sand, I suspect that the animal can scarcely be said to be suspended by its pedicle, but rather reposes on the conical part of it; by which means the folds of the branchial pouch will take a vertical and the stomach a horizontal position, and thus be more in correspondence with the ordinary position of the stomach in simple *Ascidiæ*, which is very rarely descending.

The envelope of *Cystingia Griffithsii* is exceedingly smooth, and so pellucid as to appear almost gelatinous. The original colour

colour I cannot ascertain; but if it be the same as that of the specimen in spirits, it is cinereous, rather yellowish. The external orifices have scabrous rims, are very minute and scarcely at all prominent. The branchial orifice is quadrifid, and placed exactly half-way down the side. The anal orifice is on the same line with it and the pedicle, but is placed opposite to this last, so as to be terminal, having its external surface apparently without rays; in both respects being totally different from the anal orifice of *Boltenia*.

The entrance of the branchial cavity is provided with a circular range of ten or twelve unequal tentacula, which are composite or divided into laciniæ at the extremity, which laciniæ are again so minutely divided as to be almost plumate. The branchial pouch has about fourteen folds, and its net-work is very indistinct and lax, the transverse nervures being perhaps the most visible, particularly towards the branchial orifice. The folds of the branchiæ are most easily seen on the inside of the branchial pouch.

The *pharynx* is situated rather higher than the branchial orifice; and the *œsophagus*, which is about half the length of the stomach, after ascending to the highest part of the branchial vein, descends, and gives rise to a simple but enormous stomach, having a longitudinal division, marked somewhat deeply, and which runs almost the whole length of the body in a line between the base of the pedicle and the anal orifice. The intestine is exceedingly short, and apparently descending in a line with the stomach; the rectum is cylindrical, and anus simple. Such, at least, is the description of the digestive apparatus of this animal, if we give the name of *pharynx* to that end of the intestinal canal which opens into the branchial cavity, and the name of *anus* to that end of it which is free; and there is no doubt that such a description makes it an animal totally different from *Boltenia*, and in fact

fact from all other species of *Tethya*, not only with respect to the singular form of the intestinal canal, but inasmuch as the branchial vein is thus placed, in relation to the pharynx, directly opposite to its position in all other animals of this group. I therefore am induced in some measure to suppose that there is a monstrous formation in the intestinal canal of the only specimen which I have had the means of examining; a supposition which must of course for the present throw doubt on any generic character which might be drawn from the above description of the intestinal canal. If, indeed, we could imagine that, were it not for some monstrosity of structure, the intestinal canal would communicate with the branchial cavity by that end which, from its being free, I have been obliged to consider the anus, then the whole of the internal organs of nutrition would have a situation analogous to that of those of *Boltenia*. For instance, there would then be a short œsophagus opening near the anal orifice of the envelope, an ascending stomach, a long curved intestine, and descending rectum, while the branchial vein and heart would take their usual situation in respect to the pharynx and stomach. We know, moreover, from those Memoirs of Savigny, to which I have in the course of this paper had so often occasion to refer, that the digestive organs of the *Tunicata* are subject to analogous derangements, of which he has figured two remarkable examples in *Cynthia momus* and *Phallusia turcica*. It appears, indeed, to be a consequence of the low rank of these animals in the scale of being, and of their simple organization, that the organs apparently most essential to their existence may undergo the greatest inversions without affecting their life; for the monstrous *Cynthia momus*, described by Savigny, as well as the *Cystingia*, now under consideration, had its ovaries full of eggs.

The *Cystingia Griffithsii* has no liver very distinct, unless a substance which appears to coat a very small part of the stomach

mach in a spiral form may so be considered. The stomach is internally simple, with very slight transverse striæ.

The heart is situated horizontally between the lower part of the tunic and the stomach. It is large, ovoidal, and appears to be composed of several lobes, and is indeed of a structure different from that of such *Ascididæ* as are known. There are four vertical openings to it, which are capable of being widely distended.

The *dorsal sulcus* is remarkably distinct, and proceeds from the immediate vicinity of the heart, or rather along the back of it, to that of the branchial orifice. It may be seen through the external envelope of the body, when this is viewed on the left side, and forms an arch enclosing a lesser and more pointed arch, which last appears to be nothing else than one of the folds of the branchial pouch. At the point where this last arch touches the dorsal sulcus there is in our specimen an orifice opening externally, and apparently communicating by a tube with a beautifully diaphanous longitudinal pouch, which contains nothing but two blackish nodules, one of which is longer than the other. The imperfection of the only specimen in my power to examine has prevented me from accurately ascertaining the nature and use of this organization, which appears to have nothing similar to it in any of the other *Tunicata* hitherto observed.

The third animal whose structure I have to explain belongs to the natural

Genus ASCIDIA Linn. *Cynthia* Sav.

External Character. *Body* sessile, with a coriaceous test, having both orifices quadrifid, or at least having the anal orifice very rarely transversely cleft.

Ana-

Anatomical Character. *Branchial pouch* divided into longitudinal folds, surmounted by a circle of compound or simple tentacula; the meshes of the respiratory apparatus destitute of papillæ. *Abdomen* lateral*.

SYNOPSIS OF THE SUBGENERA.

Normal group. 1. *Branchial pouch* with more than eight folds. *Tentacula* compound. *Liver* distinct....	1. Cynthia.....	*Reticulation* of the branchial pouch continuous.
	Cynthies propres Sav.	
	2. Cæsira Sav.	*Reticulation* of the branchial pouch interrupted.
Aberrant group. 2. *Branchial pouch* with only eight folds. *Tentacula* simple. *Liver* none.....	3. Styela Sav.....	*Ovaries* several, one at least on each side of the body.
	4. Pandocia Sav.	*Ovary* unique, *i. e.* only the right one, which is comprised in the intestinal loop.
	5. Dendrodoa mihi	*Ovary* unique, *i.e.* only the left one, which is ramose or branched, and situated between the branchial pouch and mantle.

The *Tunicata* agree with their contiguous group the *Mollusca* in the remarkable variation that exists in their system of generation. Like every other solitary character that can possibly be adopted for the ground-work of a zoological system, the mode of generation ought to rise in importance only in inverse proportion to its degree of variation. In a group of animals, for instance, where it varies according to the species, it is evidently of less importance, as affording natural characters, than among those groups where it remains less subject to variation.

* M. de Blainville seems not to have sufficiently studied these animals: for after giving an erroneous character to the genus *Ascidia*, and confounding it with the genus *Phallusia* and *Clavellina*, he ends with acknowledging, that with respect to the species "*leur distinction est assez difficile.*" Art. '*Mollusque*,' *Dict. des Sciences Naturelles*. Dr. Fleming has, on the other hand, given a very good view of this natural group in the art. '*Mollusca*' of the Supplement to the *Encyclopædia Britannica*.

When

When the naturalist happens to consider that he ought always to obtain his group before he attempts to find its character, he is sure to perceive this truth; and it is on this very principle, indeed, that Savigny, with his usual discrimination, has proceeded in the above natural arrangement of the genus *Ascidia*, which I have done little more than borrow from him. To this naturalist, whose works I cannot too often recommend to the careful attention of zoologists as models for imitation and true examples of the method in which Natural History ought to be studied, I would willingly have dedicated the following subgenus; but his name happens to have been employed in other branches of the science. On account of its ramose ovarium, therefore, I shall name this

Subgenus, DENDRODOA.

External Character. *Body* subcylindrical, with both orifices exceedingly minute and situated on the apex.

Anatomical Character. *Branchial pouch* marked only with eight folds, and having the reticulation continuous. *Orifices* terminal. *Tentacula* simple. *Liver* none. *Ovary* unique, branched, situated between the mantle and the branchial pouch.

Dendrodoa glandaria.

D. glandiformis, tunicâ glabrâ sub-opacâ.

Tab. XX.

Descr. *Body* subcylindrical, with a rounded summit. *Envelope* whitish, subpellucid, coriaceous and smooth, having its base rough with agglutinated pebbles; internally it has a pearly lustre, and is thickest towards the base. *Orifices* so little prominent as to be scarcely perceptible without a lens: separate from each other, and opening with four indistinct rays. *Mantle* muscular, but of uniform substance.

Tentacula about twenty-six, simple, subulate, alternately long and short.

Anterior nervous tubercle with many spirals.

Branchial cavity occupying the whole length of the animal.

Pharynx situated at the bottom of the cavity of the body. *Œsophagus* descending, and turning short round near the cardia into a cylindrical horizontal stomach, which is striated externally, and occupies with the pylorus (which turns round and lies parallel to it) the whole of the bottom of the cavity. *Intestine* very long. *Rectum* ascending, almost vertical, terminated by an anus margined.

Ovary one, situated on the left side, between the branchial pouch and the tunic. It consists of a trifurcated, cylindrical stem, having at the base, on one side, a forked branch, on the other a simple one, all of the same thickness.

This is a very singular animal in outward appearance, as it presents to the simple view no external orifices, and is shaped very much like an acorn. It appears to have been attached to some small pebbles by its base, some of which remain agglutinated to it, and give it a wrinkled appearance below. The upper part of it is coriaceous, rather smooth and subpellucid; for on compressing the body between the finger, the three branches of the ovary are very distinct. The colour of our specimen in spirits is cinereous. The top of the cylindrical body is rather flat, but rounded off at the sides. On applying a very strong power, we observe, at least in the only specimen I have had the means of examining, four apertures. Two of these are so large as to be visible with the naked eye, but are not the branchial and anal orifices, which are exceedingly minute. The two false apertures form a triangle with the branchial orifice, the space between them being rugose. The first is a semicircular cleft, which I believe to be

be accidental, as it appears in no way connected with the internal organization, although on compressing the body the fluid contents of the inside issued from this aperture. The second false aperture does not appear more connected with the internal organization than the other, but is externally of rather a complex appearance. It consists of a circular cavity, of which one half is surrounded by a thin raised margin. On one side of the interior of this cavity we see a mamillated eminence supporting two more minute mamillæ. What the use of this apparent organization is I cannot imagine, as it is situated on the space between the rings of the tentacula and the branchiæ, and seems therefore accidental. The *branchial aperture* is surrounded by a raised margin, within which we indistinctly see the four rays. On opening the animal, however, and viewing the branchial orifice from the inside, we find these four rays which compose it very distinct. The tentacula are very simple filaments, unequal in size. The folds of the branchial pouch are very distinct, and in the interval between them run two longitudinal nervures connected by transverse threads, which are again connected by short longitudinal filaments, thus forming a simple respiratory net-work.

The organs of digestion have great affinity in external structure and position to those of *Cynthia pantex* of Savigny, except that the stomach and intestine are horizontal, and the anus simply margined.

The extraordinary characteristic, however, of the animal is the many-branched unique ovary which coats the tunic on the left side behind the branchiæ, and which, when first seen through the semipellucid external envelope, gave me an idea of its internal structure being very different from what it afterwards proved to be on accurate dissection. The truth is, that different as this species is in external appearance from all other *Ascidiæ*, internally it agrees with the *Pandociæ* in almost every essential respect but the ovary.

It appears, therefore, that this singular animal completes the natural circle of the genus *Ascidia* in the most beautiful manner. It agrees with the first subgenus *Cynthia* in the nature of its branchial reticulation, and of its digestive apparatus, as above said. But *Cynthia* has two ovaries, the right one contained in the intestinal loop, and the left one coating the tunic. The first of these, or the right ovary, is the only one possessed by *Pandocia*, and the left is the only one possessed by *Dendrodoa*. The distinction between the aberrant groups of *Ascidia* depends thus upon the nature of their system of generation, as that which exists between the two normal groups depends on their system of respiration.

EXPLANATION OF THE PLATES.

Tab. XVIII.

Fig. 1. *Boltenia reniformis*, seen on the right side, and of the natural size. The specimen is probably contracted by being in spirits, as the situation of the loop of the intestine is indicated by a corresponding elevation of the envelope.

P. Pedicle.
C. Branchial orifice of envelope.
A. Anal orifice of envelope.

Fig. 2. The body of *Boltenia reniformis* (magnified) having about one-half of the external envelope cut away, and the several parts on the right side being seen *in situ*. Here the right ovary is seen lying closely confined within the loop of the intestine, of which the conical ascending rectum and scolloped anus are very prominent. The œsophagus is hid by the lower extremity of the right ovary, and by the

Trans. Linn. Soc. Vol. XIV. Tab. XVIII. p. 550.

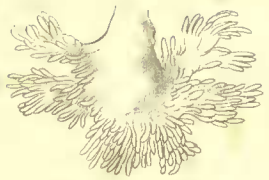

Fig. 5.

Fig. 4.

Fig. 2.

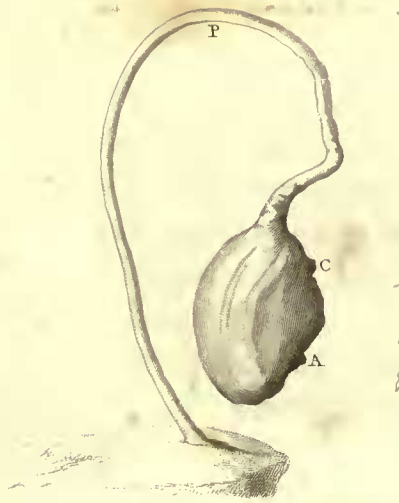

Fig. 1.

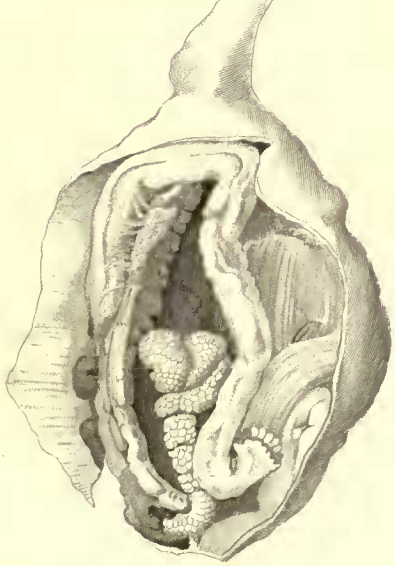

Fig. 3.

W. S. Macleay del.

Boltenia reniformis

I. Curtis &
C. Fox sculp.

the granulated liver, of which the curved commencement is seen opposite to a small mass of the left ovary, which, in cutting the envelope, has been left adhering to the mantle just under the anal orifice. The rest of the left ovary may be seen behind the ascending stomach, adhering to a fragment of the mantle, of which the muscular transverse fibres are very visible. Some of these fibres are also seen traversing the intestine and right ovary, keeping these parts as it were *in situ*. Between the intestine and the branchial orifice (which is marked on the inside by a circle of plumose tentacula) may be distinguished the folds of the reticulated branchial pouch. The anal orifice is internally somewhat elevated and quadrifid.

Fig. 3. *Boltenia reniformis* magnified, and the parts seen as in the former figure, except that the right ovary is separated from the intestine, and put aside with the stomach, so as to show the beautifully granulated lobes of the liver, which appear to be most voluminous towards the pylorus. The singular cubical lobes of the right ovary become also visible in this view of the several parts.

Fig. 4. Outline of *Boltenia reniformis* magnified as before. The intestine and right ovary being removed from their place, in order to show the position of the other parts more distinctly.

A. Anal orifice.

B. Branchial pouch.

C. Branchial orifice.

T. Circle of tentacular filaments, which surround in a pulpy irregular form the inner part of the branchial orifice.

D. Dorsal sulcus.

E. Frag-

E. Fragment of envelope.
K. Right ovary.
k. Left ovary.
O. Œsophagus entering into the branchial pouch, immediately behind which is the pharynx.
L. Liver coating the stomach.
I. Intestine.
R. Rectum.
H. Anus.

Fig. 5. One of the tentacular filaments of the branchial orifice highly magnified.

Tab. XIX.

Fig. 1. *Cystingia Griffithsii*, seen on the right side, and of the natural size. The translucid nature of the envelope permits us to see the position of the stomach, heart, and left ovary. The pedicle is encrusted at the base with minute grains of sand.

Fig. 2. *Cystingia Griffithsii* magnified, and seen on the left side. The transparency of the external envelope permits us to see the external arch of the dorsal sulcus, and the pointed internal arch touching the former at a point where there is a lateral orifice. Immediately below this we see the left ovary through the transparent envelope, and a little on one side is that dark-coloured nodule, which on dissection appears to be contained in a pouch.

C. Branchial orifice.
A. Anal orifice.
S. Grains of sand that externally encrust the thick end of the pedicle.

Fig. 3. Outline of the *Cystingia Griffithsii* much magnified, to show the various parts *in situ* on a portion of the right side of the envelope being removed.

A. Anal

Fig. 1.

Fig. 2.

Fig. 3.

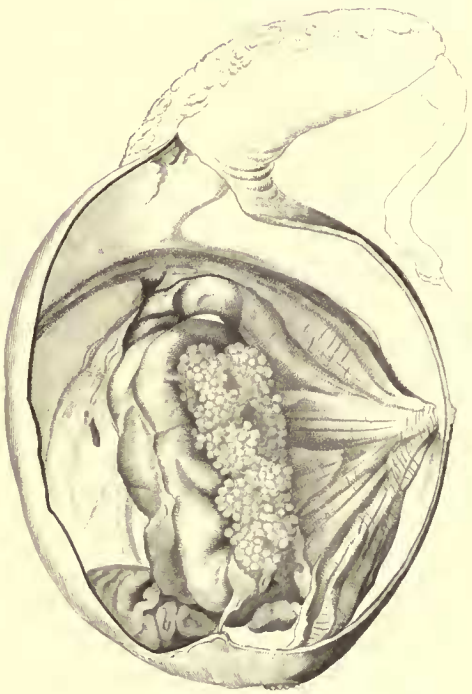

Fig. 4.

Fig. 5.

Fig. 6.

Cystingia Griffithsii

W. S. Macleay del.

I. Curtis &
C. Fox sculp.